PATENT ABSTRACTS OF JAPAN

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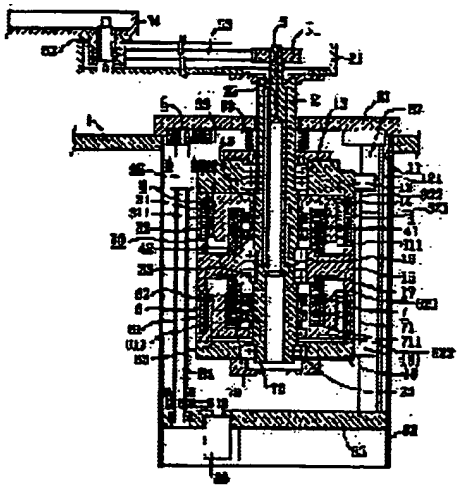
(54) ARTICULATED ROBOT

(57)Abstract:
PROBLEM TO BE SOLVED: To reduce the height of an arm driving part so as to reduce the whole of a robot by using a motor comprising a stator having a smooth core armature and a cup-like rotor as a motor for driving an arm, and inserting the motor in the inside of a position detector rotor.
SOLUTION: A first position detector 4 is inserted in the inside of a first motor 3, and a second position detector 7 is inserted in the inside of a second motor 6, so that the height of an arm driving part 10 is reduced so as to reduce the whole of a robot. Further, as the first motor 3 and the second motor 6 are so constructed that a stator is formed by a smooth core armature, torque ripple is small. Even if a gap between the stator and the rotor is enlarged, there is little influence of lowering of torque, so that even in a large-sized motor, an armature coil is sealed by a can having enough strength to form a high output arm driving part suitable for vacuum environment.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to what drives an arm especially with a direct drive about the articulated robot used in vacuum environments, such as a semiconductor manufacturing installation.

[0002]
[Description of the Prior Art] Although the articulated robot used in a vacuum environment is conventionally equipped with the mechanical component which drives two or more arms, in order for a mechanical component to prevent emitting the gas which forms in series the motor which carries out the direct drive of each arm on one shaft, respectively, and occurs from the insulator of each motor etc. to a vacuum environment, it arranges a mechanical component on the outside of a vacuum chamber, and has sealed the coil fraction of a motor or a position transducer by the can. For example, the level articulated robot used in a vacuum environment is constituted as shown in drawing 2 . That is, it attaches and 1 is the 1st bracket with which a vacuum chamber and 100 were prepared in the mechanical component, and 11 was prepared in the vacuum chamber 1 and with which the hole and the bar 1120 were attached in the installation hole 11. 20 is the hollow-like 1st output shaft, and is supported through the bearing 130 with which the 1st bracket 120 was equipped. 140 is the 1st casing of the shape of hollow attached in the 1st bracket 120 in the shape of a said core. 150 is the 2nd bracket attached in the edge of the 1st casing 140 in the shape of a said core, and is supporting the 1st output shaft 20 through bearing 160. 21 is the 1st arm extended horizontally, is arranged inside the vacuum chamber 1 and is being fixed to the point of the 1st output shaft 20 projected in the vacuum chamber 1. 30 is the 1st motor and 310 is the stator of the shape of a ring of the 1st motor 30, and it has equipped with the armature coil 3110 into the slot prepared in inner circumference, and is fixed inside the 1st casing 140. 320 is the rotator of the 1st motor 30, and it is being fixed to the 1st output shaft 20 so that it may counter through an opening inside a stator 310. 170 is the hollow-like 2nd casing and is attached in the 2nd bracket 150 in the shape of a said core. 180 is the 3rd bracket attached in the edge of the 2nd casing 170. The 1st position transducer with which 40 detects the position of the 1st output shaft 20, and 410 are equipped with a sensing coil 4110 by the fixed part of the shape of a ring of the 1st position transducer 40, and are being fixed inside the 1st casing 140. 420 is the rotation section of the 1st position transducer 40, and it is being fixed to the 1st output shaft 20 so that it may counter through an opening inside a fixed part 410.
[0003] 50 is the hollow-like 2nd output shaft, it is arranged inside the 1st output shaft 20, and is supported by the 1st output shaft 20, the 2nd bracket 150, and the 3rd bracket 180 through bearing 220, 230, and 240, and the point is projected inside the vacuum chamber 1. The 1st pulley with which 51 was fixed to the point of the 2nd output shaft 50, the 2nd pulley with which 52 was supported free [the rotation to near the nose of cam of the 1st arm 21], the belt with which 53 was almost wound around the 1st pulley 51 and 2nd pulley 52, and 54 are the 2nd arm fixed to the 2nd pulley 52. 60 is the 2nd motor and 610 is the stator of the shape of a ring of the 2nd motor 60, and it has equipped with the armature coil 6110 into the slot prepared in inner circumference, and is fixed inside the 2nd casing 170. 620 is the rotator of the 2nd motor 60, and it is being fixed to the 2nd output shaft 50 so that it may counter through an opening inside a stator 610. 70 is equipped with the 2nd position transducer, 710 is equipped with a sensing coil 7110 by the fixed part of the 2nd position transducer 70, and it is fixed inside the 2nd casing 170. 720 is the rotation section of the 2nd position transducer 70, and it is being fixed to the 2nd output shaft 50 so that it may counter through an opening inside a fixed part 710. 34 is the 1st can which consists of a cylinder-like nonmagnetic steel plate, and the inside of the fixed part 410 of the 1st position transducer 40 and the inside of the stator 310 of the 1st motor 30 are covered, and an edge is attached in the 1st casing 140 and 2nd bracket 150, and has sealed the armature coil 3110 and the sensing coil 4110. 640 is the 2nd can which consists of a cylinder-like nonmagnetic steel plate, and the inside of the fixed part 710 of the 2nd position transducer 70 and the inside of the stator 610 of the 2nd motor 60 are covered, and an edge is attached in the 2nd casing 170 and 2nd bracket 150, and has sealed the armature coil 6110 and the sensing coil 7110.
[0004]
[Problem(s) to be Solved by the Invention] However, there were the following problems with the above-mentioned conventional technique.
(1) Since the 1st motor 30, the 1st position transducer 40, the 2nd motor 60, and the 2nd position transducer 70

are arranged in series on one rotation axis, the height of the mechanical component of each arm becomes high, and the whole robot becomes large.
(2) Since it has equipped with each armature coil of the 1st above-mentioned motor 30 and the 2nd motor 60 into the slot prepared in the inner circumference of each stator, a torque ripple is large and it is difficult to make an arm movement smooth.
(3) Although the wrap 1st can 34 and, and the 2nd can 64 are inserted for the inside of stators 310 and 610 into the gap between each stator and each rotator, since a gap is about 0.5mm, as for the usual motor which equipped with the armature coil into the slot, thickness of a can cannot be enlarged, but the intensities of a can run short by the large-sized motor, and sufficient seal effect is not acquired.
(4) Since the 1st above-mentioned motor 30 and the 2nd motor 60 insert a can into the above-mentioned gap, although it is necessary to enlarge a gap, in order to compensate a decrement of the flux density for it, the outer diameter of each stator becomes large. Therefore, when the outer diameter of each rotator is small and it drives a large load like a robot arm to the outer diameter of a motor, an inertia ratio (proportion of the moment of inertia of Rota and a load) becomes large, and the servo-control property of a motor becomes bad. this invention aims at offering the compact articulated robot in which the stable servo control can be done.
[0005]
[Means for Solving the Problem] The 1st motor by which this invention drives the 1st arm in order to solve the above-mentioned technical probrem, The 1st position transducer which detects the position of the 1st aforementioned motor, and the 2nd motor which drives the 2nd arm supported by the 1st aforementioned arm free [rotation], The 2nd position transducer which detects the position of the 2nd aforementioned motor, In the articulated robot equipped with the mechanical component which has arranged the can of the shape of a cylinder which seals the sensing coil of the can of the shape of a cylinder which seals the armature coil of the 1st aforementioned motor and the 2nd aforementioned motor, respectively, the 1st aforementioned position transducer, and the 2nd aforementioned position transducer, respectively on the same axle The stator of the shape of a ring in which the 1st aforementioned motor and the 2nd aforementioned motor have a smooth core armature, respectively, The rotator of the shape of a cup arranged, respectively is prepared inside the aforementioned stator, the 1st aforementioned position transducer is arranged inside the rotator of the 1st aforementioned motor, and the 2nd aforementioned position transducer is arranged inside the rotator of the 2nd aforementioned motor. Moreover, the fixed part of the stator of the 1st aforementioned motor and the 2nd aforementioned motor and the 1st aforementioned position transducer, and the 2nd aforementioned position transducer is arranged besides a vacuum environment through the aforementioned can, and, as for the aforementioned mechanical component, the rotation section of the rotator of the 1st aforementioned motor and the 2nd aforementioned motor and the 1st aforementioned position transducer, and the 2nd aforementioned position transducer is arranged in the aforementioned vacuum environment. Moreover, the aforementioned mechanical component is equipped with the lifting device prepared in the outside of the aforementioned vacuum chamber.
[0006]
[Embodiments of the Invention] Hereafter, the example which shows this invention in drawing is explained. Drawing 1 is a right cross section showing the example of this invention. In drawing, it is the mechanical component which drives the 1st arm 21 which 1 is arranged at a vacuum chamber, and 10 is arranged on the outside of the vacuum chamber 1, and is mentioned later, and the 2nd arm 54. It attaches and 11 is the hole and the 1st bracket with which 12 has been arranged in the vacuum chamber 1 which were prepared in the vacuum chamber 1. 2 is the hollow-like 1st output shaft, it is supported through the bearing 13 with which the 1st bracket 12 was equipped, and the point is projected inside the vacuum chamber 1. 14 is the 1st casing of the shape of hollow attached in the 1st bracket 12 in the shape of a said core. 15 is the 2nd bracket attached in the edge of the 1st casing 14 in the shape of a said core, and is supporting the 1st output shaft 2 through bearing 16. 21 is the 1st arm extended horizontally, is arranged inside the vacuum chamber 1 and is being fixed to the point of the 1st output shaft 2 projected in the vacuum chamber 1. 3 is the 1st motor, 31 is the stator of the shape of a ring of the 1st motor 3, and it is fixed inside the 1st casing 14. The armature coil 311 formed in the inner circumference of a stator 31 in the shape of a cylinder is pasted up with a resin, and the smooth core armature is formed (the manufacture technique is indicated by JP,63-283455,A concerning application of these people). It is formed in the shape of a cup of the disk section 322 in which the bond part of the body 321 and the 1st output shaft 2 in which the magnetic pole was formed was formed. 32 is the rotator of the 1st motor 3, it is arranged so that a body 321 may counter through an opening to an armature coil 311 inside a stator 31, and the disk section 322 is being fixed to the 1st output shaft 2. 33 is the 1st can for motors which consists of a cylinder-like nonmagnetic steel plate, it is fixed to the 1st casing 14 so that the inner skin of an armature coil 311 may be worn, and it has sealed the armature coil 311. Therefore, although the rotator 32 of the 1st motor 3 is arranged in a vacuum environment, a stator 31 is arranged in the atmospheric air.
[0007] It has a sensing coil 411 by the fixed part of the shape of a ring of the 1st position transducer 4, and is fixed to the 2nd bracket 15, and the 1st position transducer with which 4 detects the position of the 1st output shaft 2, and 41 are arranged through the opening inside the body 321 of the 1st motor 3. 42 is the rotation section of the 1st position transducer 4, and it is being fixed to the 1st output shaft 2 so that it may counter through an opening inside a fixed part 41. 43 is the 1st can for position transducers which consists of a cylinder-like nonmagnetic steel plate, it is fixed to a fixed part 41 so that the inner skin of a sensing coil 411 may be worn, and it has sealed the sensing coil 411. Therefore, although the rotation section 42 of the 1st position transducer 4 is arranged in a

CLAIMS

[Claim(s)]

[Claim 1] The 1st motor which drives the 1st arm, and the 1st position transducer which detects the position of the 1st aforementioned motor, The 2nd motor which drives the 2nd arm supported by the 1st aforementioned arm free [rotation], The 2nd position transducer which detects the position of the 2nd aforementioned motor, In the articulated robot equipped with the mechanical component which has arranged the can of the shape of a cylinder which seals the sensing coil of the can of the shape of a cylinder which seals the armature coil of the 1st aforementioned motor and the 2nd aforementioned motor, respectively, the 1st aforementioned position transducer, and the 2nd aforementioned position transducer, respectively on the same axle The stator of the shape of a ring in which the 1st aforementioned motor and the 2nd aforementioned motor have a smooth core armature, respectively, It is the articulated robot characterized by preparing the rotator of the shape of a cup arranged, respectively inside the aforementioned stator, arranging the 1st aforementioned position transducer inside the rotator of the 1st aforementioned motor, and arranging the 2nd aforementioned position transducer inside the rotator of the 2nd aforementioned motor.

[Claim 2] The aforementioned mechanical component is an articulated robot according to claim 1 with which the fixed part of the stator of the 1st aforementioned motor and the 2nd aforementioned motor and the 1st aforementioned position transducer, and the 2nd aforementioned position transducer is arranged besides a vacuum environment through the aforementioned can, and the rotation section of the rotator of the 1st aforementioned motor and the 2nd aforementioned motor and the 1st aforementioned position transducer, and the 2nd aforementioned position transducer is arranged in the aforementioned vacuum environment.

[Claim 3] The aforementioned mechanical component is the articulated robot [equipped with the lifting device prepared in the outside of the aforementioned vacuum chamber] according to claim 1 or 2.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional side elevation showing the example of this invention.
[Drawing 2] It is the sectional side elevation showing the conventional example.
[Description of Notations]
1: a vacuum chamber, 10:mechanical component, 11:installation hole, and 12: — the 1st bracket — 13, 16:bearing, and 14: — the 1st casing and 15: — the 2nd bracket — 17: — the 2nd casing and 18: — the 3rd bracket and 2: — the 1st output shaft — 21: — the 1st arm, 22 and 23, 24:bearing, and 3: — the 1st motor — 31: A stator, 311:armature coil, 32:rotator, 321:body, 322:disk section and 33: — the 1st can for motors, and 4: — the 1st position transducer — 41:fixed part, 411:sensing coil, 42:rotation section, and 43: — the 1st can for position transducers — 5: — the 2nd output shaft and 51: — the 1st pulley and 52: — the 2nd pulley and 53:belt — 54: — the 2nd arm and 6: — the 2nd motor, 61:stator, and 611:armature coil — 62:rotator, 621:body, 622:disk section, and 63: — the 2nd can for motors, and 7: — the 2nd position transducer, 71:fixed part, 711:sensing coil, 72:rotation section, and 73: — the 2nd can for a position detection, 8:lifting device, 84:ball thread, 85:nut, and 86:drive motor

[Translation done.]

vacuum environment. a fixed part 41 is arranged in the atmospheric air. 17 is the hollow-like 2nd casing and is attached in the 2nd bracket 15 in the shape of a said core. 18 is the 3rd bracket attached in the edge of the 2nd casing 17. 5 is the hollow-like 2nd output shaft, it is arranged inside the 1st output shaft 2, and is supported by the 1st output shaft 2, the 2nd bracket 15, and the 3rd bracket 18 through bearing 22, 23, and 24, and the point is projected inside the vacuum chamber 1. The 1st pulley with which 51 was fixed to the point of the 2nd output shaft 5, the 2nd pulley with which 52 was supported free [the rotation to near the nose of cam of the 1st arm 21], the belt with which 53 was almost wound around the 1st pulley 51 and 2nd pulley 52, and 54 are the 2nd arm fixed to the 2nd pulley 52. 6 is the 2nd motor, 61 is the stator of the shape of a ring of the 2nd motor 6, and it is fixed inside the 2nd casing 17. The armature coil 611 formed in the inner circumference of a stator 61 in the shape of a cylinder is pasted up with a resin, and the smooth core armature is formed. It is formed in the shape of a cup of the disk section 622 in which the bond part of the body 621 and the 2nd output shaft 5 in which the magnetic pole was formed was formed, 62 is the rotator of the 2nd motor 6, it is arranged so that a body 621 may counter through an opening to an armature coil 611 inside a stator 61, and the disk section 622 is being fixed to the 1st output shaft 2. 63 is the 2nd can for motors which consists of a cylinder-like nonmagnetic steel plate, it is fixed to the 2nd casing 17 so that the inner skin of an armature coil 611 may be worn, and it has sealed the armature coil 611. Therefore, although the rotator 62 of the 2nd motor 6 is arranged in a vacuum environment, a stator 61 is arranged in the atmospheric air.

[0008] It has a sensing coil 711 by the fixed part of the shape of a ring of the 2nd position transducer 7, and is fixed to the 2nd bracket 15, and the 2nd position transducer with which 7 detects the position of the 2nd output shaft 5, and 71 are arranged through the opening inside the body 621 of the 2nd motor 6. 72 is the rotation section of the 2nd position transducer 7, and it is being fixed to the 2nd output shaft 5 so that it may counter through an opening inside a fixed part 71. 73 is the 2nd can for position transducers which consists of a cylinder-like nonmagnetic steel plate, it is fixed to a fixed part 71 so that the inner skin of a sensing coil 711 may be worn, and it has sealed the sensing coil 711. Therefore, although the rotation section 72 of the 2nd position transducer 7 is arranged in a vacuum environment, a fixed part 71 is arranged in the atmospheric air. The lifting device to which 8 makes a mechanical component 10 fluctuate, and 81 cover the installation hole 11 of the vacuum chamber 1, and it is a lower adapter plate, and the case of the up adapter plate which has opening which makes the edge of the 1st output shaft 2 project, and the shape of a cylinder by which 82 was attached inside the installation hole 11, and 83 keep a spacing underneath the mechanical component, are arranged, and are being fixed to the case 82. 84 is a ball thread and, as for the lower part, the upper part is supported by the up adapter plate 81 free [the rotation to the lower adapter plate 83]. 85 is the nut which engages with a ball thread 84, and is being fixed to the 1st bracket 12. 86 is a screw-thread drive motor which drives a ball thread 84 through a belt etc. 87 is a guide rail, and it is prepared between the up adapter plate 81 and the lower adapter plate 83, engages with the lobes 121 and 181 of the 1st bracket 12 and the 3rd bracket 18, and enables it to have carried out the straight-line move of the mechanical component 10 up and down. 88 is the bellows for vacuum seals prepared between the up adapter plate 81 and the mechanical component 10.

[0009] Since the 2nd position transducer is inserted inside the 2nd motor by inserting the 1st position transducer 4 inside the 1st motor by such configuration, the height of an arm mechanical component becomes low and the whole robot can be made small by it. Moreover, for the 1st motor 3 and the 2nd motor 6, since the stator is formed of the smooth core armature, a torque ripple is the parvus. And even if it enlarges the gap between a stator and a rotator, the influence of a torque fall can use the thick can whose thickness is about 1mm by the parvus's. Therefore, by the can of sufficient intensity, an armature coil can be completely sealed also by the large-sized motor, and the arm mechanical component of the high power suitable for the vacuum environment can be formed. Furthermore, since the 1st motor 3 and the 2nd motor 6 are stators which do not have a slot using a smooth core armature, they can make thickness of a stator small. Therefore, since the outer diameter of a rotator can be enlarged to the outer diameter of a motor and an inertia ratio can be brought close to 1, the servo-control property of a motor becomes very good, and an operation of an arm becomes smooth. In addition, since a mechanical component 10 can fluctuate by the lifting device 8, the operating range of an arm spreads. In addition, although the above-mentioned example explained the level articulated robot equipped with two arms, by what restricts an arm to what is maintained horizontally, there is nothing, the shaft of a mechanical component is arranged horizontally, and, as for this invention, the thing which makes it move perpendicularly can also apply two or more arms. Moreover, this invention can prepare the output shaft of one or more hollow into an output shaft in the air, and can apply it to the articulated robot equipped with two or more arms by driving by the so-called gap winding motor equipped with the stator which has a smooth core armature for each output shaft, and the cup-like rotator.

[0010]

[Effect of the Invention] It is effective in the ability to offer the good articulated robot of a controllability suitable for the vacuum environment, while the height of an arm mechanical component becomes low and the whole robot can be made small like according to this invention, since it is made the configuration inserted in the motor which was described above, and which drives an arm inside the position-transducer rotator using the motor which consists of a stator which has a smooth core armature, and a cup-like rotator.

[Translation done.]